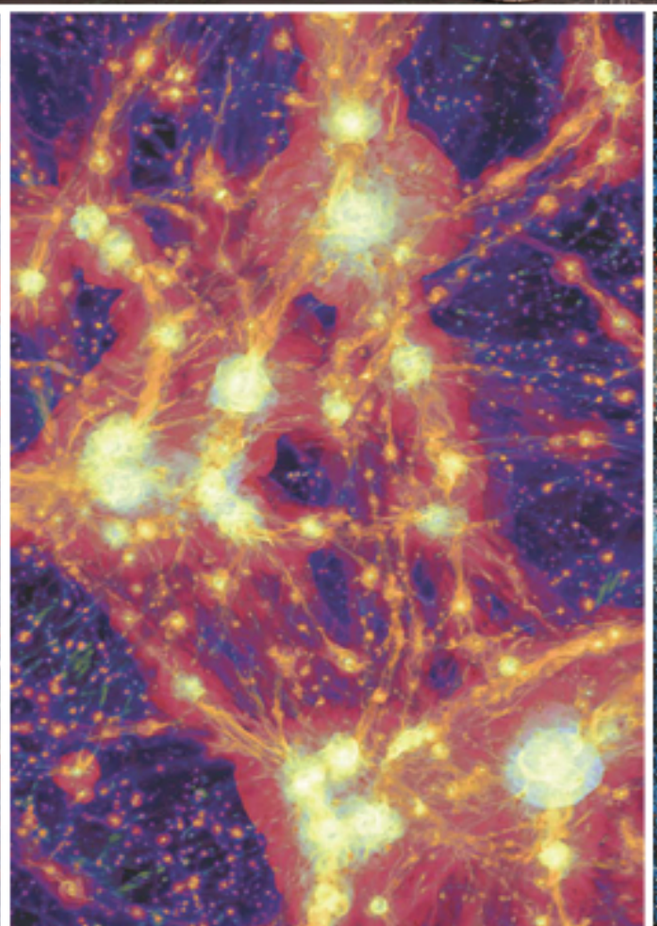
SKA France

The French community towards the Square Kilometre Array

Chiara Ferrari
Astronomer at Observatoire de la Côte d'Azur
Director of SKA France



Timeline of the SKA project

2009 — 2010 — 2011 — 2012 — 2015 — 2016 — 2017 — 2018 — 2019 →

Revision of French roadmap

AS SKA-LOFAR

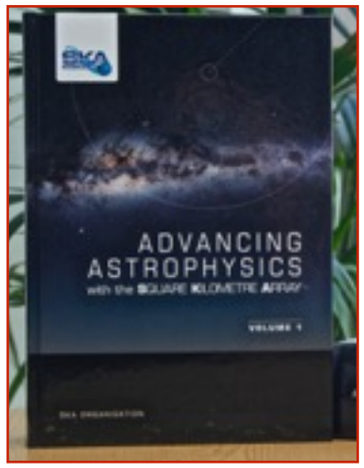
PrepSKA

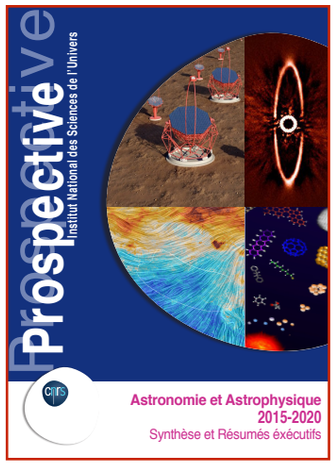
SKADS

BUT: French withdrawal from the SKA

SKA FRANCE
SQUARE KILOMETRE ARRAY

cnrs · l'Observatoire de Paris · Observatoire de la Côte d'Azur · université de BORDEAUX · UNIVERSITÉ D'ORLÉANS





PO for France joining SKAO

NenuFAR

The SKA France coordination

Workshops

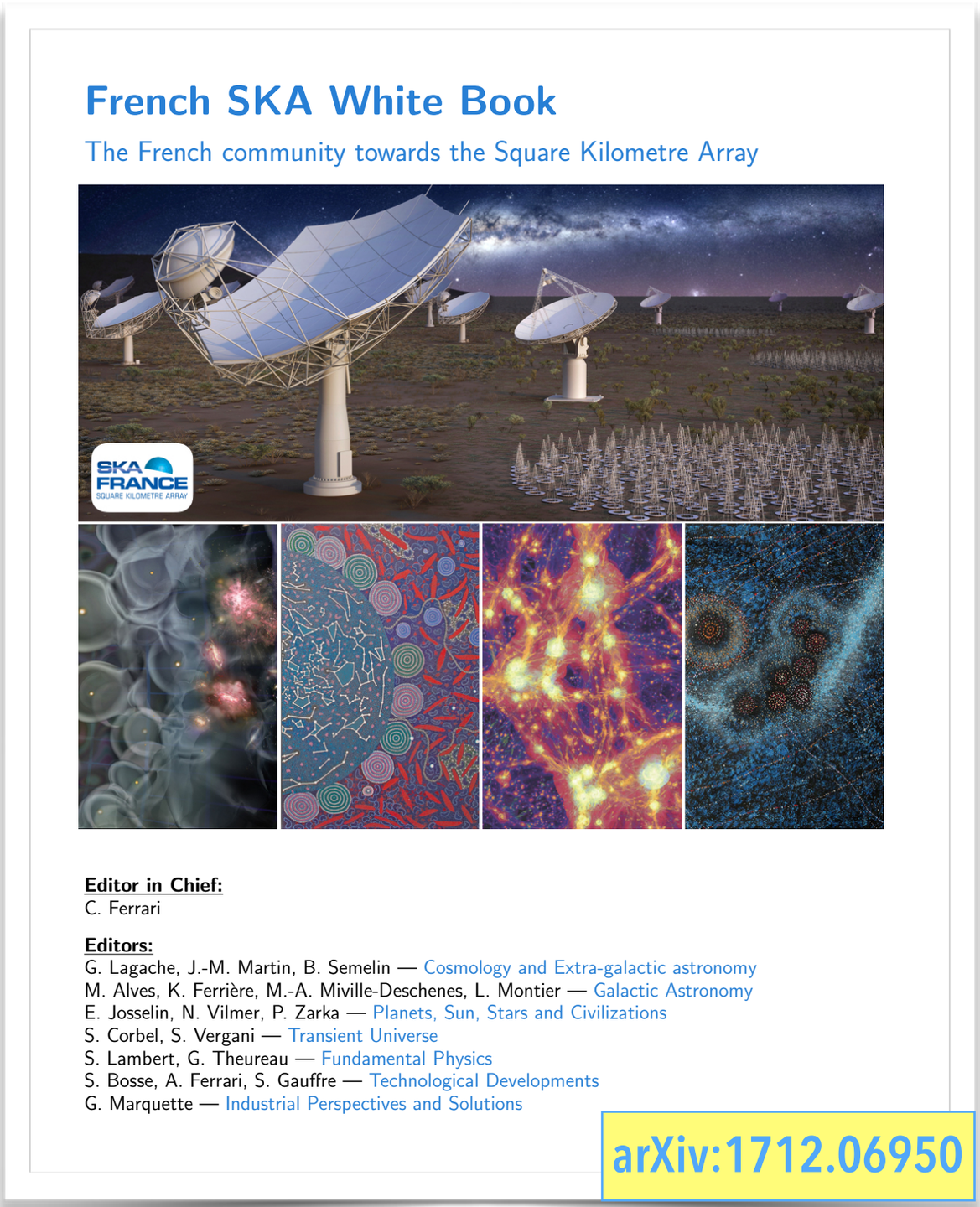
Web page

Big events

Seminars

Monthly bulletins

The French SKA White Book



French SKA White Book

The French community towards the Square Kilometre Array

Editor in Chief:
C. Ferrari

Editors:
G. Lagache, J.-M. Martin, B. Semelin — Cosmology and Extra-galactic astronomy
M. Alves, K. Ferrière, M.-A. Miville-Deschenes, L. Montier — Galactic Astronomy
E. Josselin, N. Vilmer, P. Zarka — Planets, Sun, Stars and Civilizations
S. Corbel, S. Vergani — Transient Universe
S. Lambert, G. Theureau — Fundamental Physics
S. Bosse, A. Ferrari, S. Gauffre — Technological Developments
G. Marquette — Industrial Perspectives and Solutions

arXiv:1712.06950

176 authors from

- 40 French research institutes

- 6 private companies

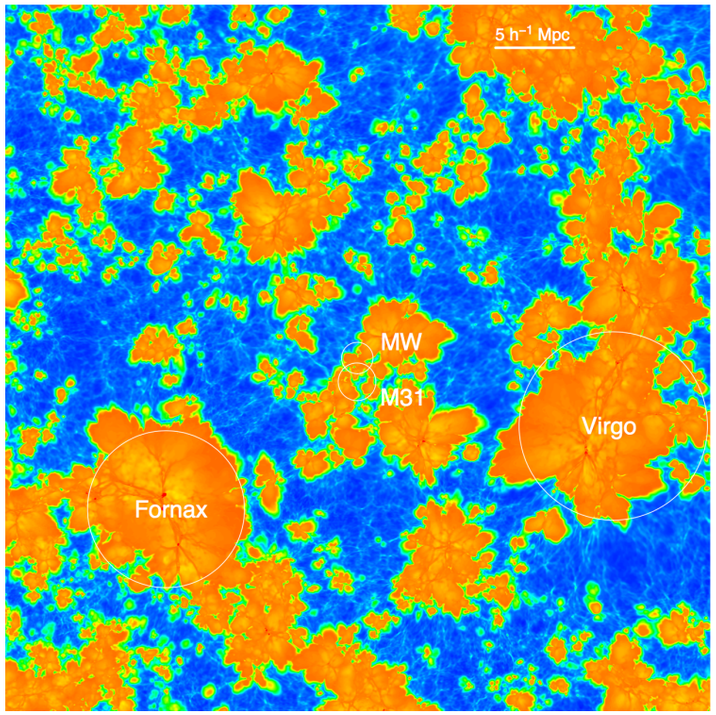
A wider and wider community and strong interdisciplinary incentives

JIVE
Joint Institute for VLBI ERIC

EUROPEAN vlbi NETWORK

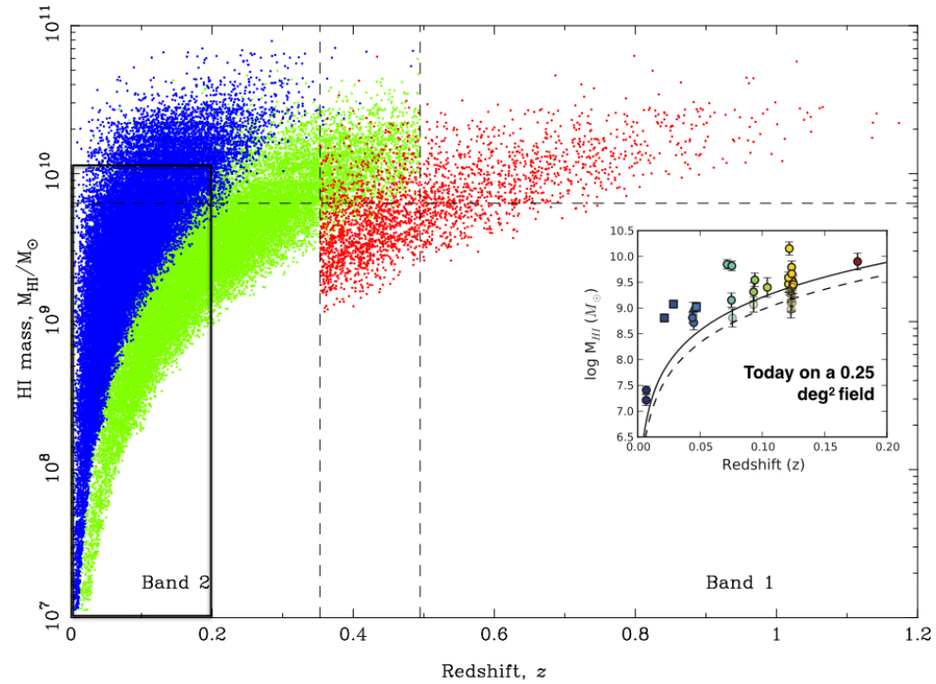
VLBI

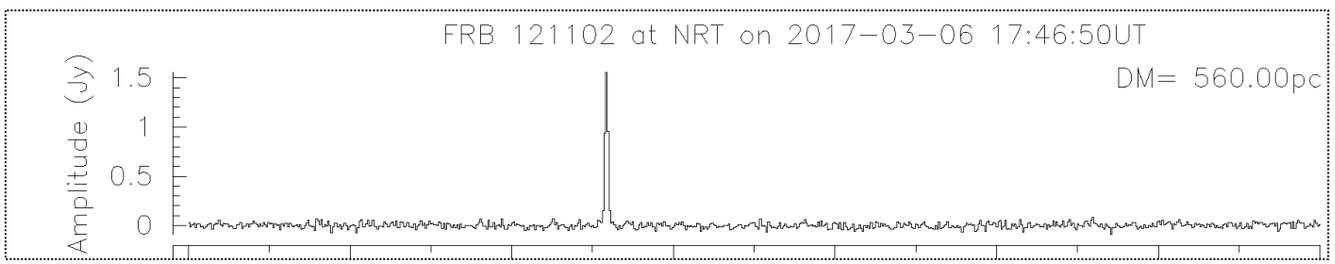
- All SKA Science Working Groups have French participants
- Sixteen French researchers (co-)authors of more than 30 out of the 135 chapters of the SKA Science Book



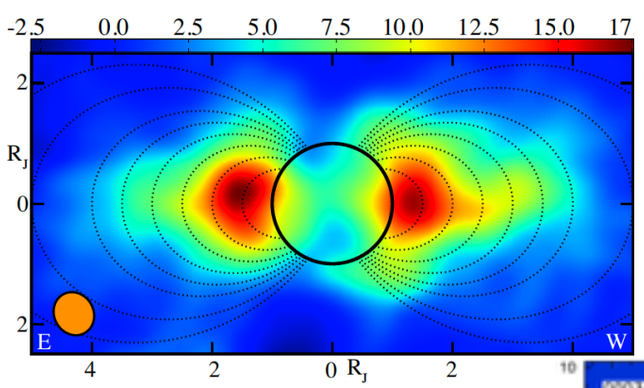
Ocvirk+ 16

Adapted from Staveley-Smith & Osterloo 15 & Fernàndez+ 13



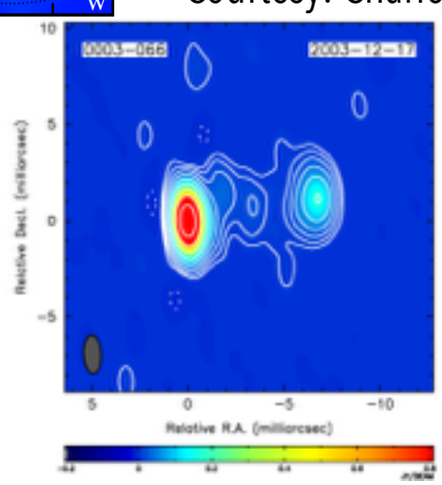


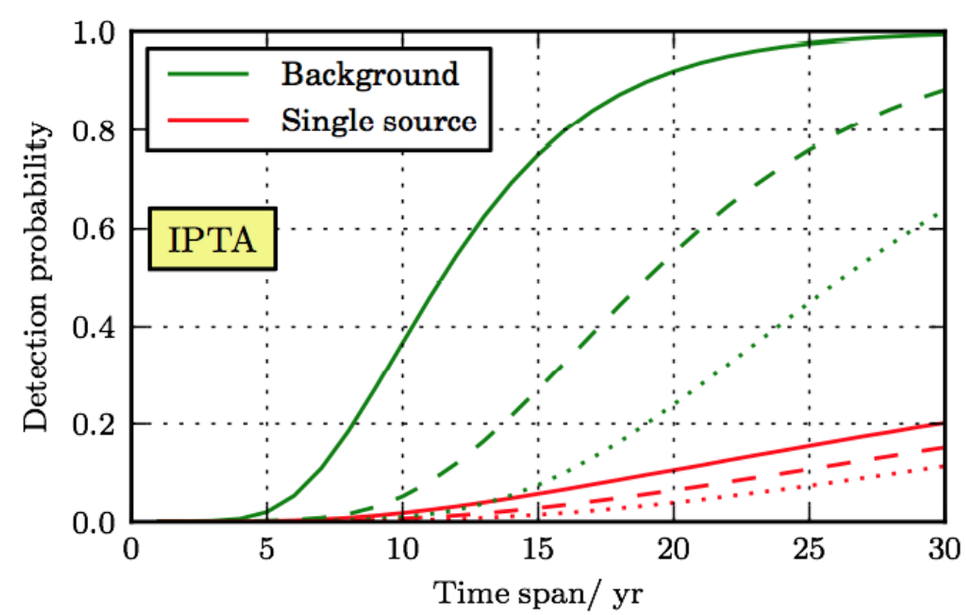
Courtesy: Cognard+



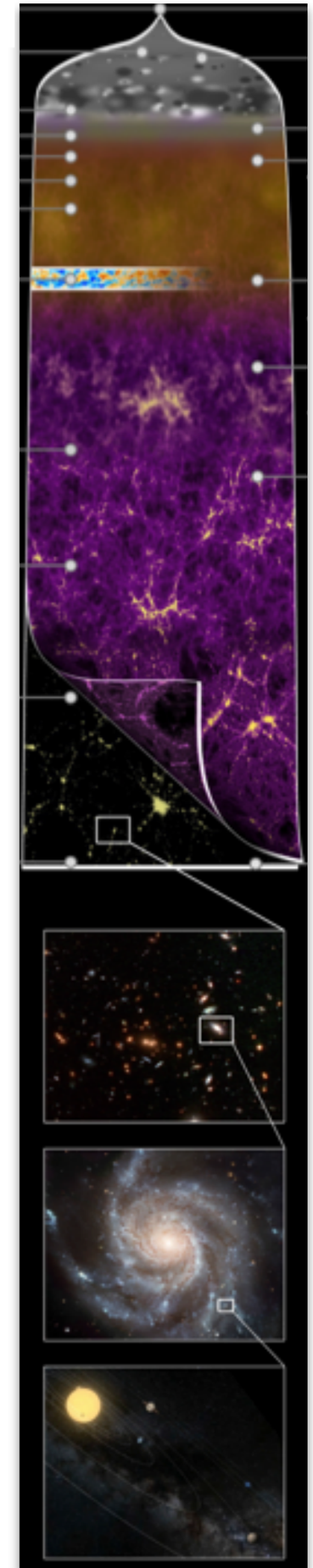
Girard+ 16

Courtesy: Charlot+





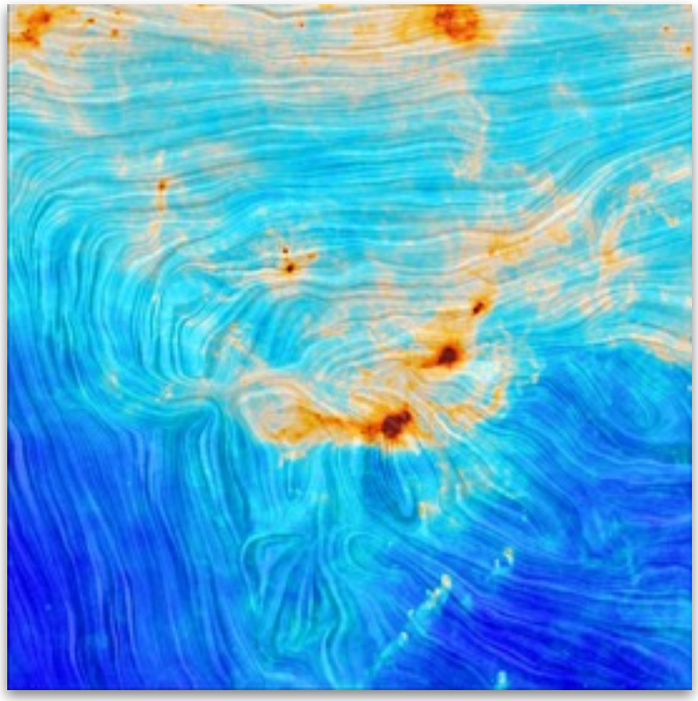
Rosado + 15



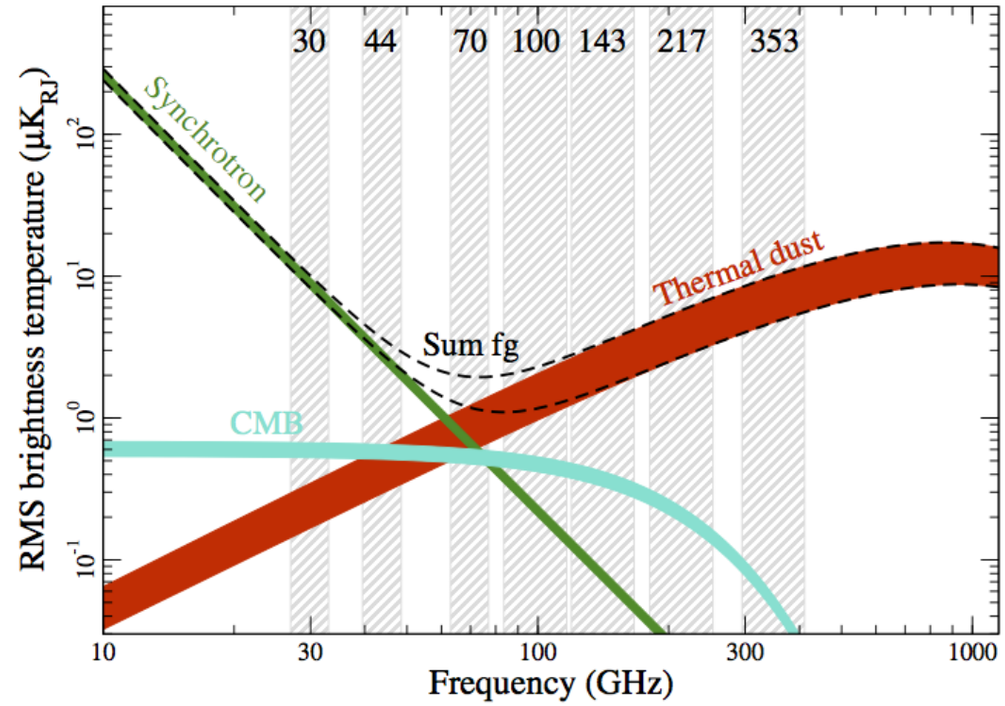
FRANCE SQUARE KILOMETRE ARRAY

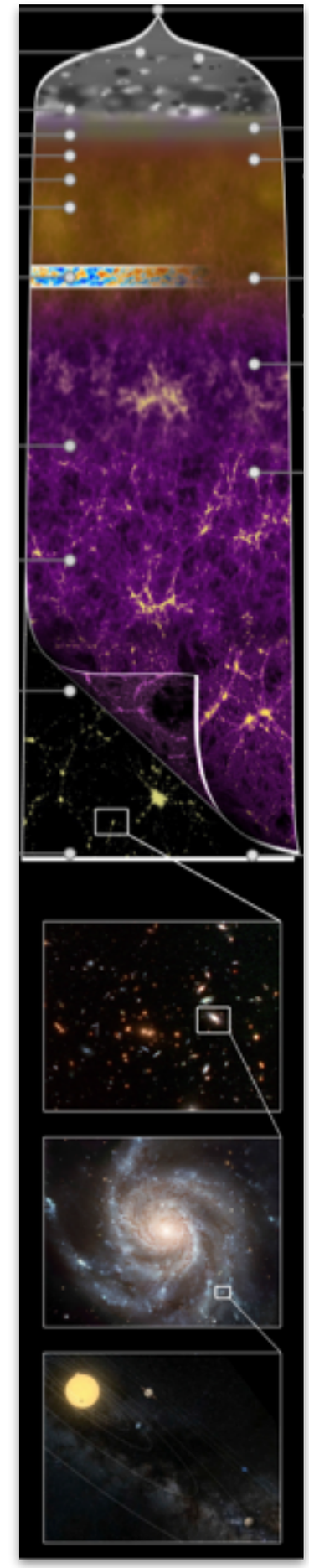
A wider and wider community and strong interdisciplinary incentives

- The richest synergy chapter ever published about SKA vs. other projects, including:
  - instruments covering the whole electromagnetic spectrum
  - gravitational wave detectors

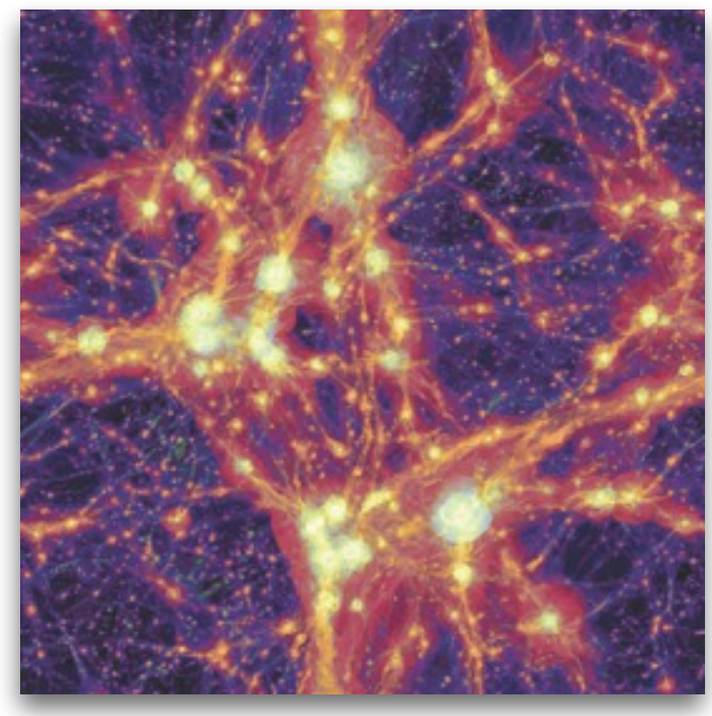


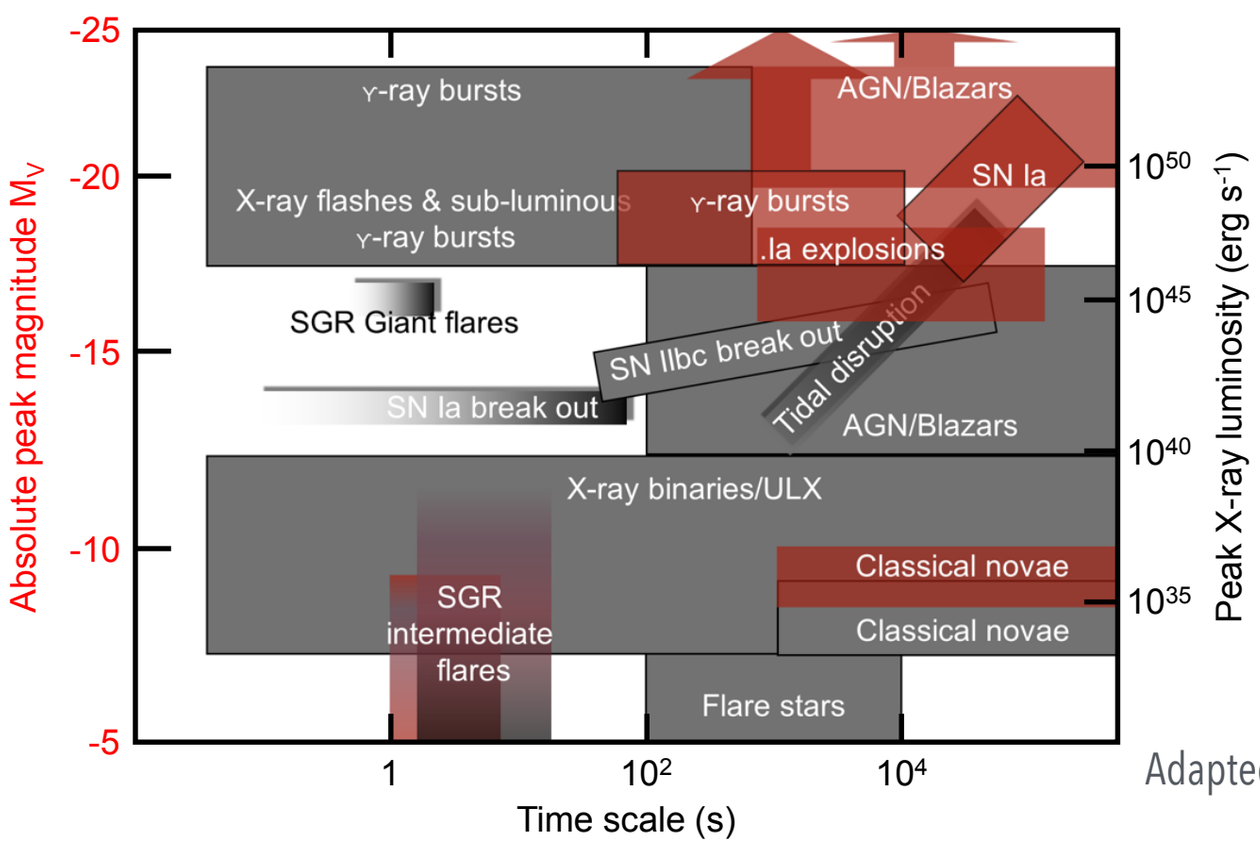
Planck coll. 16





Vazza + 17





Adapted from Jonker+ 13

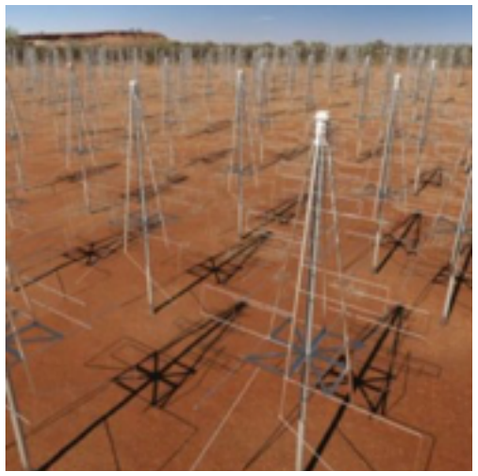
SKA FRANCE
SQUARE KILOMETRE ARRAY

Building this fantastic machine: technological developments in France

SKA1-MID

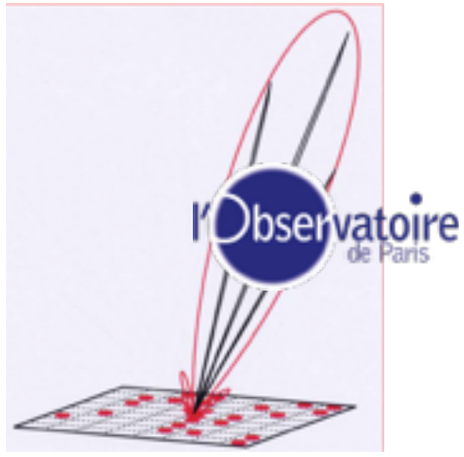
/s

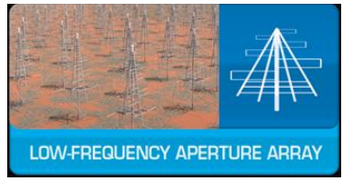
7.2 Tb/s



SKA1-LOW

~2 Pb/s





Observatoire de la COTE d'AZUR

l'Observatoire de Paris

UNIVERSITE D'ORLEANS

French researchers push forward radio image quality in view of the SKA telescope

Goa, India, Thursday 10 November - Novel image processing techniques have been discussed today at the 2016 SKA Science Conference in Goa, India, as French researchers have updated the international astronomy community on promising work being undertaken in France to develop new algorithms for radio astronomy, with potential applications beyond.

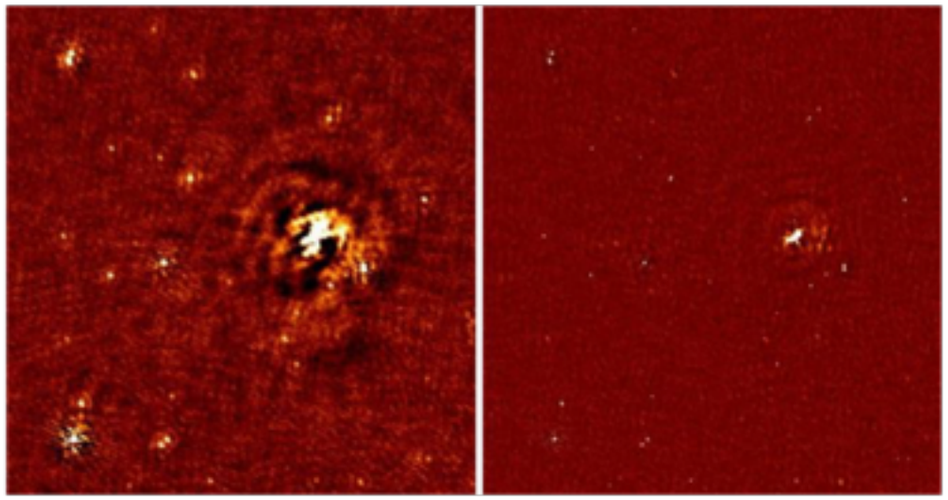
French teams from Observatoire de Paris, Observatoire de la Côte d'Azur, AIM Laboratory, ENS Cachan and Université Paris X are actively working on state-of-the-art algorithms for calibration and deconvolution – removal of artefacts in the images – of radio astronomy observations.

"Adaptive optics" for radio astronomy

A French team from Observatoire de Paris led by Dr Cyril Tasse is working on developing the equivalent of "adaptive optics" for radio astronomy. Adaptive optics systems – as used in world-class optical astronomy facilities such as ESO's VLT in Chile – measure how atmospheric turbulence affects known sources in the sky, to then deform active mirror surfaces and compensate for the turbulence, thus resulting in much sharper images. In effect, these systems almost correct the effects of the atmosphere.

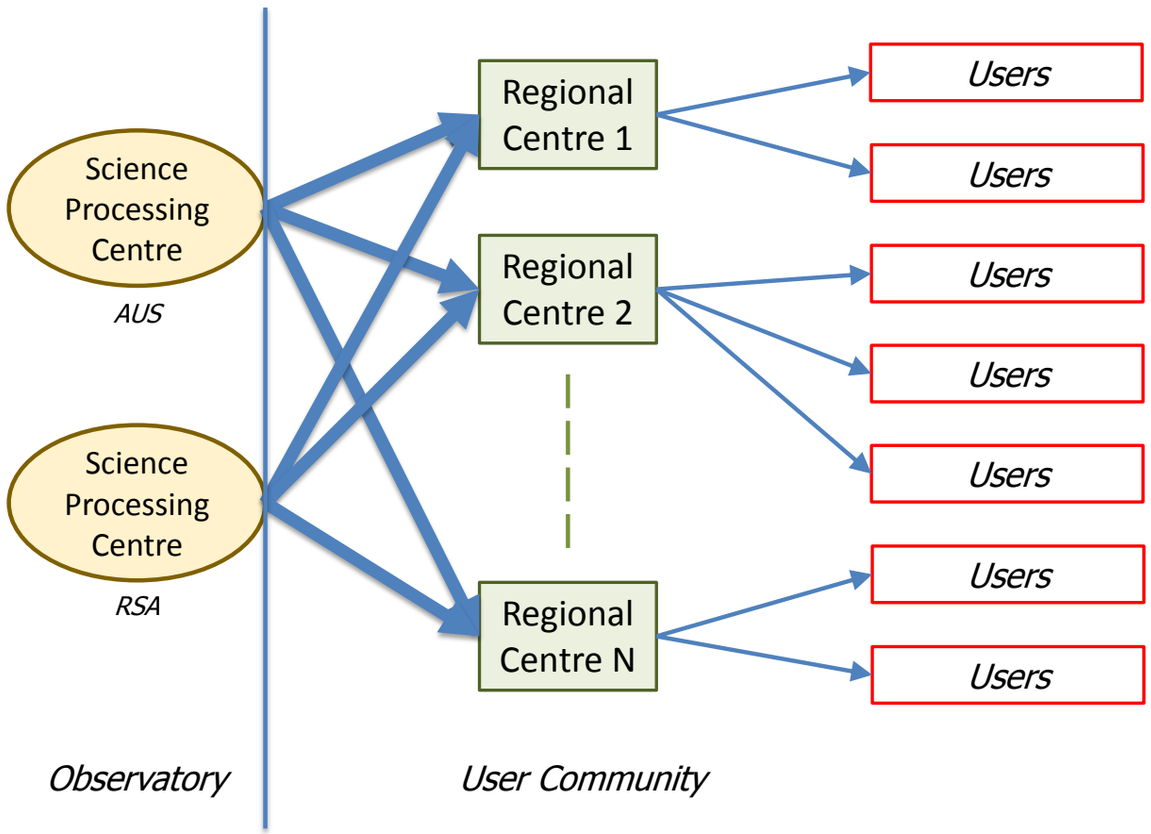
"In optical astronomy, you apply this correction to the mirror. In radio-astronomy you apply the correction in the supercomputer doing the image processing", explains Dr Chiara Ferrari, Coordinator of SKA-France (*see note*).

While self-calibration tools already exist in radio astronomy, the French team has developed next-generation "direction-dependent" algorithms that cope with the changing nature of the ionosphere over the observed portion of the sky. These algorithms measure how the signal from known sources in the sky in the area of observation is affected by the turbulence from the ionosphere, and then apply a correction in post processing to cancel those effects. The team recently tested their algorithm on observations of the international LOFAR telescope (from the LOFAR Surveys project, led by Prof Röttgering), producing very promising results.



Results of classical (left) and next-generation calibration (right) on a small portion of the so-called « Bootes field » observed for 8 hours with the LOFAR telescope at 150MHz (data courtesy: LOFAR Surveys, Röttgering et al.)

France within the organisation of the SKA European Regional Data Centre

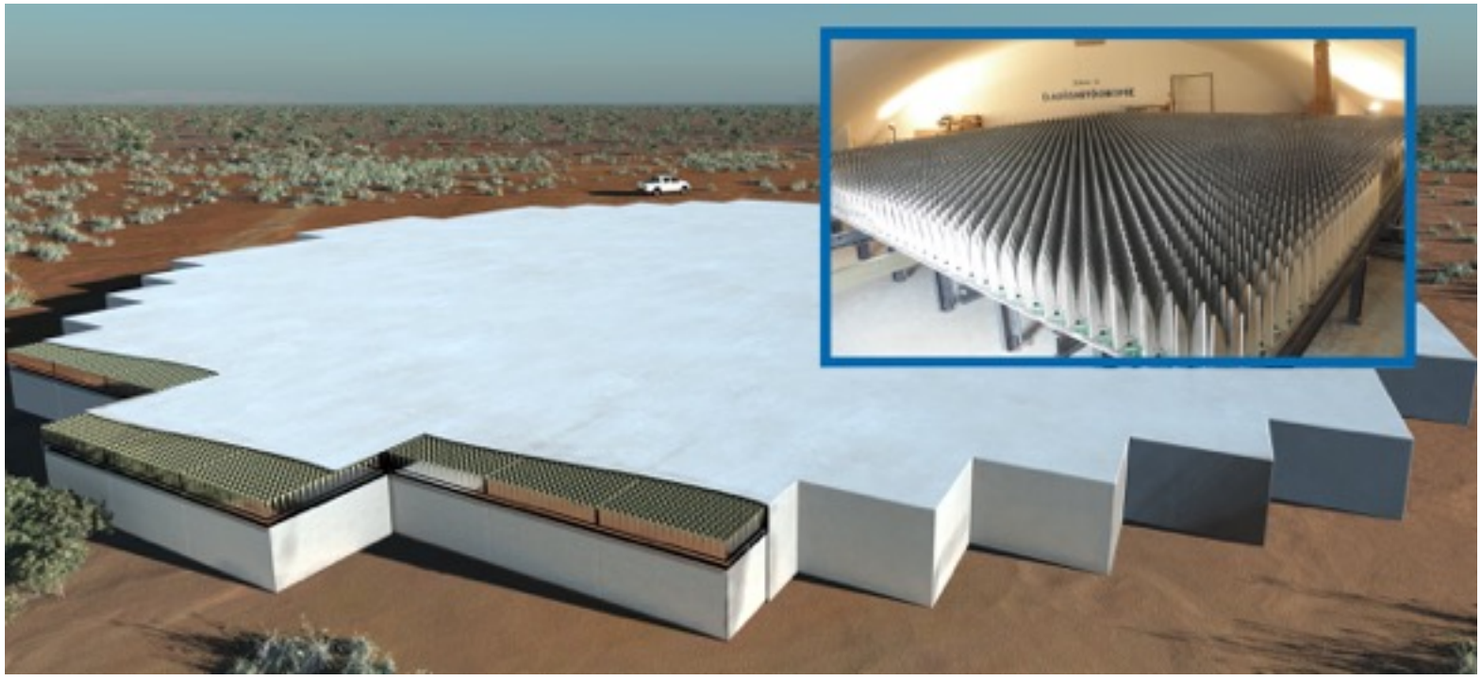


Aeneas
Advanced European Network of E-infrastructures for Astronomy with the SKA

European Commission
Horizon 2020
European Union funding for Research & Innovation

- **J.-P. Vilotte (CNRS):**
  member of the External Advisory Board
  (with I. Bird @ CERN & M. Zwaan @ ESO)
- **C. Ferrari (OCA):**
  chair of the General Assembly

Advanced Instrumentation Programme



MID-FREQUENCY APERTURE ARRAY

l'Observatoire de Paris

université de BORDEAUX

See Miroslav's talk

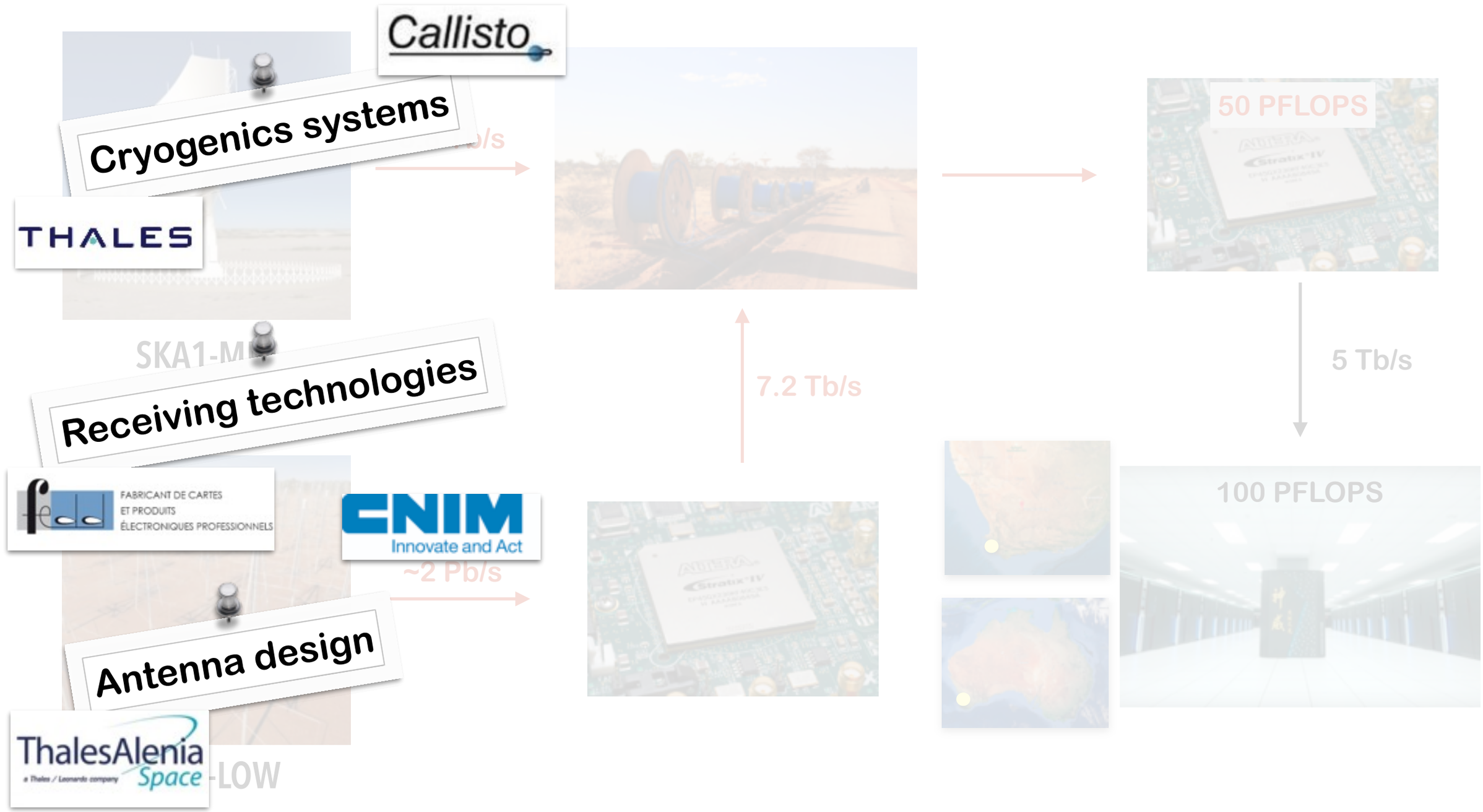
WIDE BAND SINGLE PIXEL FEEDS

université de BORDEAUX

Industrial perspectives and solutions

THALES
AIRBUS SAFRAN LAUNCHERS
IBM
FABRICANT DE CARTES ET PRODUITS ÉLECTRONIQUES PROFESSIONNELS
ENGIE
NOKIA
Callisto
KALRAY
Alcatel·Lucent
life.augmented
DDN STORAGE
Schneider Electric
AEG
EDF
TOTAL
SAFT
NVIDIA
intel
Alcatel·Lucent
Bull atos technologies
CNIM Innovate and Act
Air Liquide creative oxygen

Industrial perspectives and solutions



Industrial perspectives and solutions

Industrial perspectives and solutions

SKA1-MID

8.8 Tb/s

ThalesAlenia Space

Data science for monitoring

THALES

Bull atos technologies

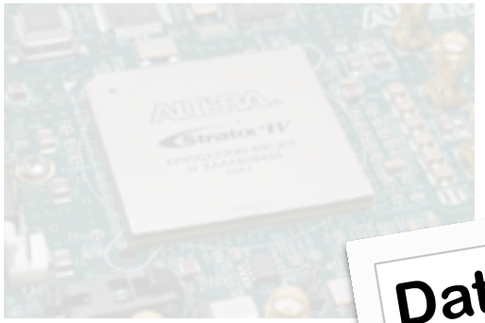
Hardware and application integration

KALRAY

7.2 Tb/s

SKA1-LOW

~2 Pb/s



100 PFLOPS

DDN STORAGE

Data storage, distribution, preservation

THALES

Industrial perspectives and solutions

ThalesAlenia Space

System engineering

arianeGROUP

SKA1-MID

8.8 Tb/s

50 PFLOPS

5 Tb/s

100 PFLOPS

7.2 Tb/s

~2 Pb/s

SKA1-LOW

Industrial perspectives and solutions

ThalesAlenia Space

System engineering

ArianeGROUP

ThalesAlenia Space

Callisto

Cryogenics systems

Data science for monitoring

Bull atos technologies

THALES

Telecommunications

THALES

ThalesAlenia Space

Hardware and application integration

KALRAY

Receiving technologies

Air Liquide creative oxygen

FABRICANT DE CARTES ET PRODUITS ÉLECTRONIQUES PROFESSIONNELS

CNIM Innovate and Act

Energy production and storage

DDN STORAGE

Antenna design

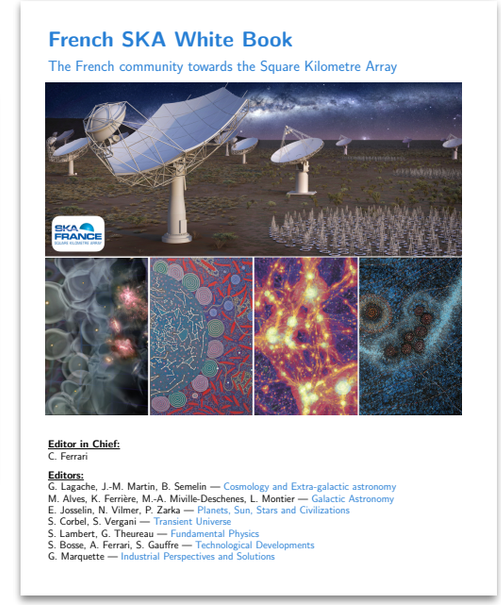
ENGIE

Data storage, distribution, preservation

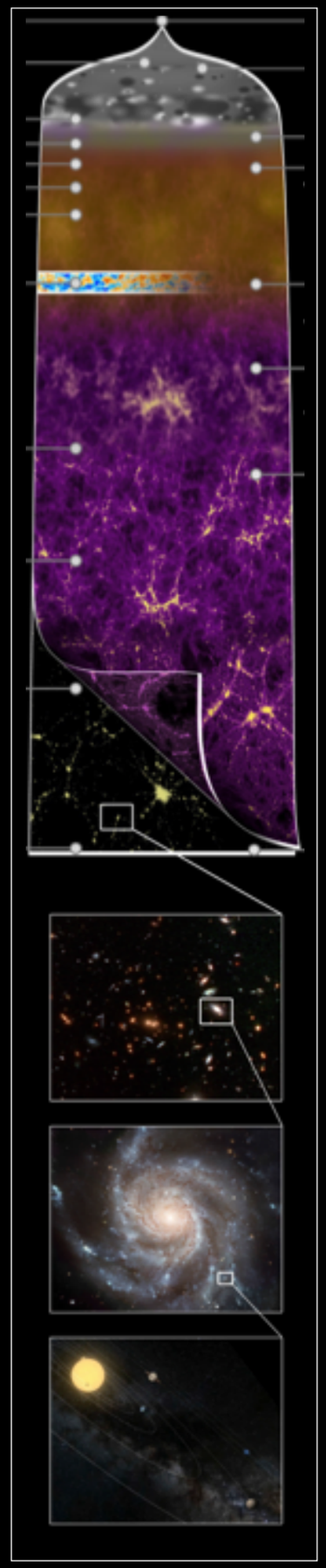
ThalesAlenia Space

THALES

SKA-France milestones



- SKA-France Day on October 16, 2017
- A new structure : « Maison SKA France »
  - PPP: instrument in response to the necessity of an innovative financial approach
  - Kick-off meeting on February 1st, 2018
- Biennial revision of the National Roadmap for Large Research Infrastructures
  - SKA in as a project: announcement on May 17, 2018
  - French application for joining the SKAO company with financial contribution of MSF
  - Next French roadmap revision in 2020



THANKS!

SKA FRANCE
SQUARE KILOMETRE ARRAY